of the invention.

Fig. 44 is a sectional view of the structure of the first embodiment of a separated recording/reproducing magnetic head which incorporates the magnetoresistance effect device of the invention.

Fig. 45 is a sectional view of the structure of the second embodiment of a separated recording/reproducing magnetic head which incorporates the magnetoresistance effect device of the invention.

Fig. 46 is a perspective view of the structure of one embodiment of a magnetic head assembly which incorporates the separated recording/reproducing magnetic head of the invention.

Fig. 47 is a perspective view of the structure of one embodiment of a magnetic disc system which incorporates the separated recording/reproducing magnetic head of the invention.

Fig. 48 is a graph of an XRD pattern of the spin valve film as produced in Example 1 of the invention.

Fig. 49 is a sectional view of the essential part of one embodiment of an artificial lattice film which incorporates the magnetoresistance effect device of the invention.

Fig. 50 is a conceptual view showing the cross section of a spin valve device part as seen from its ABS (air baring surface). ABS may comprise a protective film formed thereon.

Fig. 51 is a perspective view of a spin valve device with its gap film and shield film being removed.

Fig. 52 is a conceptual view of one embodiment of a head which is suitable to the top-type spin valve film of Fig. 1 and Fig. 5.

Fig. 53 is a graph of the data of nano-EDX analysis of the cross section of a magnetic head which incorporates the magnetoresistance effect device of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the invention are described in detail hereunder with reference to the drawings.

First Embodiment:

First mentioned is the embodiment of the invention in which the free layer (first ferromagnetic layer) is thinned.

The problems with the technique of "thinning the free layer" which the present inventors have recognized in the process of achieving this embodiment of the invention are described in detail.

As so mentioned hereinabove, remarkable increase in the sensitivity of magnetoresistance effect devices is realized not only by increasing the MR ratio but also by reducing the thickness of the free layer (that is, by reducing the product of Ms×t). In a broad way, the output increases, being in reverse proportion to the product of Ms×t of the free layer.

However, the present inventors' own investigations have verified that the technique of thinning the free layer brings about the following problems.

The first problem is that the bias point designing in an applied sense current is difficult. When all the magnetic fields applied to the free layer being driven are summed up and when the bias point is in the center of the linear inclination of a transfer curve, the biasing condition will be the best. However, when the free layer is thinned, the inclination of the transfer curve becomes steep. In that condition, it is extremely difficult to lead the bias point to the center of the linear region of the transfer curve. In a bad bias point condition, asymmetric signals will be formed, and in a worse condition, no output level could be taken.

The second problem is that, if the free layer is thinned to an extreme degree according to a prior art technique, the MR ratio is greatly lowered. The reduction in the MR ratio causes the reduction in the reproducing output.

Fig. 7A and Fig. 7B are conceptual views for explaining the two problems with conventional magnetoresistance effect devices. In those drawings, shown are the transfer curves of magnetic heads each having a magnetoresistance effect device. Fig. 7A shows one case where the free layer is thick; and Fig. 7B shows another case where the free layer is thin. As mentioned above, when the free layer is thinned, the